U.S. Department of Energy
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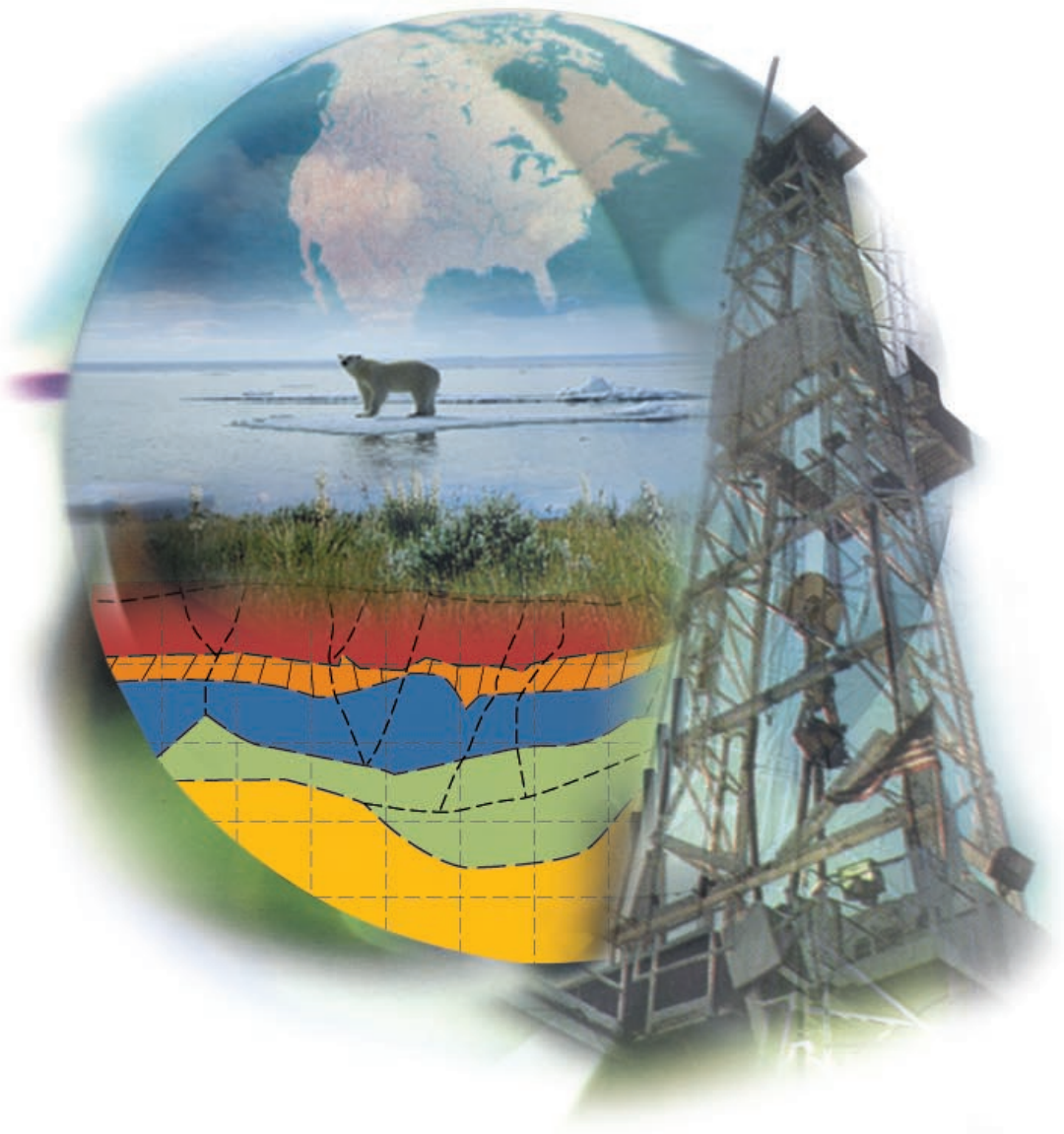


Environmental Benefits of Advanced Oil and Gas Exploration and Production Technology

Site Restoration

ON LAND AND OFFSHORE, OIL AND GAS PRODUCERS HAVE DEVELOPED INNOVATIVE WAYS TO RESTORE SITES TO ORIGINAL — AND SOMETIMES BETTER-THAN ORIGINAL — CONDITION, FOR DIVERSE USES RANGING FROM HOUSING TO AGRICULTURE TO WILDLIFE HABITATS.

Photo: Corbis Images

Leaving a Positive Environmental Legacy

Diamond Y Spring in West Texas, a rare desert spring habitat, has been the site of an actively producing oil and gas field for decades. It also has been the focus of preservationists since the 1960s, with the discovery there of the Leon Springs pupfish, a species thought to be extinct. Pecos County cattle rancher M. R. Gonzales, who bought the property in 1969, was instrumental in bringing the spring's ecological significance to the attention of oil companies operating in the area. After a series of oil spills around the property, a diversion dike was build in 1974 to protect the headspring from any future spills.

The Nature Conservancy turned to the oil companies active in the area to provide funds for the purchase of Diamond Y Spring in 1990. Donations were made by Enron Corporation, Exxon, and the Mobil Foundation, and an innovative partnership was forged with these and other oil companies to establish protection and reclamation projects in the area of the springs. Old flow lines were replaced, pipelines near the spring system were encased in steel, many well sites were diked and bermed, abandoned wells were plugged, road construction was minimized, and areas were revegetated with native grasses and marshland flora. Today, the Leon Springs pupfish—together with rare snails, a unique salt-tolerant sunflower, the endangered Pecos gambusia fish, javelinas, foxes, and other species—continue to flourish on this unique desert spring property.

Source: The Nature Conservancy

Farming and oil and gas production have coexisted beneficially for decades in rural America.

After 15 to 30 years of production, most oil or natural gas wells reach their economic limit. It is time to pack up and move on. Wellheads, pumpjacks, tanks, pipes, facilities, equipment… everything has to be removed from the site. The wells are then permanently plugged with cement to prevent future flow of subterranean fluids into the wellbore.

The vast majority of abandoned or ophaned wells in the United States today are a legacy of the industry's earliest environmental practices, when operators took only rudimentary steps to inhibit the fluids left in the formation or the wellbore from flowing to the surface, to restore the land, or to remove used equipment. These practices often created animosity with landowners, prompting State governments to address issues associated with past closures. Today's industry is responding to the environmental challenges of past closures and is treating site restoration as a critical operational activity. Specialized teams now handle site restorations, using new technology and approaches that often result in reduced liability as well as enhanced environmental conditions.

At land-based sites, the wellbore is plugged to confine the producing formation and to protect valuable groundwater resources. Waste-handling pits and other facilities are closed, and the location is then restored to near-original condition or prepared for its intended future use, whether as agricultural land, as a wildlife habitat, or as an industrial, residential, or commercial development site. Current strategies include maximizing reuse of equipment and materials still appropriate for other applications.

Closure of offshore facilities has begun only recently, so the legacy of past practices is not at issue here as it is with land-based sites. Decommissioning and removing offshore installations is a complex process, both legally and technically. It is essential to meet the wide variety of regulatory requirements and to ensure that the marine environment is not compromised. Alternative approaches are total or partial removal of the installation, or toppling on site. All require planning and preparation years in advance.

Advanced site restoration techniques enhance marine habitats.

Restoring, and Even Improving, Habitats

Today's site restoration strategies are significantly more environmentally protective than past approaches. In some instances, these strategies actually enhance the environment and create economic benefits.

"Rigs-to-reefs"...presenting homes for marine life

Decommissioning operations, especially in the Gulf of Mexico, have been largely dependent on the use of explosives. But shock waves from the blasts can damage sea life, other nearby installations, and surface vessels. And when an obsolete rig structure is towed to shore, cut up, and sold for scrap metal, the platform's artificial reef habitat is eliminated and the area's ecosystem is upset.

In the "rigs-to-reefs" approach, massive offshore platforms are toppled and sent to the bottom of the ocean, providing several acres of living and feeding habitat for thousands of underwater species. The first planned rigs-to-reefs conversion took place in Florida in 1979. In 1983, the Minerals Management Service—the agency that manages leasing, exploration, and development of Federal offshore lands—announced its support for rigs-to-reefs programs. These programs are beneficial from many perspectives. Marine life is enhanced. Oil companies realize considerable savings from avoided removal costs.

And States receive a share of the savings as the companies donate operating platforms or obsolete rigs, construct reefs, and donate funds from their savings to support and enhance the State's marine ecosystems.

In 1984, the Federal government passed the National Fishing Enhancement Act, which further strengthened the program. Louisiana and Texas followed suit in 1986 and 1990, respectively, forming their own programs. Today all five States bordering the Gulf of Mexico have artificial reef programs, and such reefs also are found in other locations around the world.

Rigs make ideal artificial reefs. Constructed of corrosion-resistant steel that withstands displacement or breakup, rigs have a large, open structure that allows easy circulation for fish and provides havens for barnacles, corals, sponges, clams, bryozoans, and hybroids. Within six months to a year after a rig is initially placed on the sea floor, it will be a thriving reef ecosystem completely covered with marine life. When it is toppled, the newly created reef attracts additional mobile invertebrates and other fish species and an even more complex food chain develops.

The rigs-to-reefs approach saves the industry millions of dollars a year and also yields economic benefits for States:

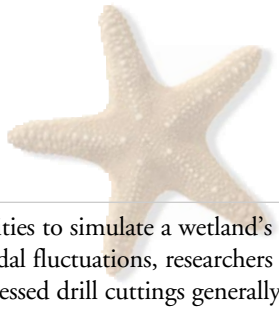
- Generally 50 percent of the industry savings is donated to a host State's artificial reef program.
- Commercial and recreational fishing and recreational scuba diving prosper from the conversion, in turn increasing local tourism.
- Commercial divers are used for nearly all phases of the conversion.

Oilfield pits and pads... changing eyesores to assets

Caliche, the crust of calcium carbonate that forms on the stony soil of arid regions, is common in drilling pads and pits in many oil fields in Texas. A program recently initiated by the University of Texas converts these pits and pads into no-maintenance wildlife habitats. In the program, the pads and pits are recontoured to a depth of 18 inches, shrubs, grass, and forbs are planted, and a functional hydrologic cycle is reestablished. Natural recovery processes following drilling and production are accelerated and can quickly transform sites into desirable habitats.

Drill cuttings to create or restore wetlands

With assistance from DOE's National Petroleum Technology Office, Southeastern Louisiana University is exploring whether drill cuttings can be safely used to restore and create wetlands. Using unique temperature-controlled mesocosm greenhouse



facilities to simulate a wetland's full range of tidal fluctuations, researchers found that processed drill cuttings generally exhibited low levels of toxicity and appeared capable of supporting healthy wetlands vegetation. In some cases, the elemental composition of restored drill cuttings was found to be very similar to dredge spoil currently in use as a wetlands creation substrate.

New approaches to reclaiming and remediating abandoned well sites

The Oklahoma Energy Resources Board (OERB), with support from the U.S. Department of Energy, has been evaluating and restoring abandoned and orphaned drilling and production sites with no current owner or operator. Since 1995, OERB has restored more than 1,000 sites across 52 counties, and restoration is in process at an additional 500 sites. Under the OERB program, oil and gas producers and royalty owners in Oklahoma voluntarily finance the site clean-up—the landowner pays nothing, and OERB is not reimbursed from any other source. The OERB effort was the Nation's first industry-funded environmental cleanup and education program. Today, similar programs have been adopted in several other States.

Road mix from nonhazardous oilfield waste

In road building, native soils are typically excavated to prepare a road base and then used as aggregate (course binding material) in the on-site mixing process. For roads in oil and gas operations, a recently developed approach uses recycled crude oil tank residuals and other nontoxic wastes as an aggregate. Although this practice has limited application, it has proven effective in reducing particulate matter from unpaved roads and other road dust emissions. Roads of these materials provide all-weather access to remote exploration and production sites, improve driving conditions, and decrease dust generation in production areas.

Case Study

From Oil Fields to Housing

Here are two illustrations of how effectively exploration and production sites and their wastes can be adapted for reuse:

California (United States)

When the West Coyote oil field was discovered in 1909 near La Habra, California, it was 10 miles from the nearest town. By 1980, the field was nearly depleted and was surrounded by housing developments. Since then, Chevron's real estate management group has converted the field from a potential liability into a prime real estate asset through careful abandonments of tank farms, oil wells, and multiple surface facilities, and subsequent site restoration—all in line with very strict environmental regulations and constraints. The rolling hills are now the site of premium homes.

Colombia (South America)

In looking at options for disposing of drill cuttings from its Colombian operations, BP Amoco staff came up with a new answer: using the cuttings as a raw material for bricks. The deceptively simple idea has met a vital need in the local community, where building materials had been scarce and expensive. The approach has also eliminated the environmental impacts of traditional disposal methods, which involved placing lime-fixated cuttings in lined pits. Today, the bricks are manufactured by local companies, using a combination of cement and water-based drill cuttings. Cuttings produced from drilling just one well can make up to 700,000 new bricks.

Beyond the Oil Patch

Developments resulting from the restoration of oil and gas E&P sites have been adapted and applied to the restoration of a wide variety of industrial facilities.